Machine Learning for Robotics SS 2017
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Due-date: 01.06.2017 (hand in at beginning of recitation session)
Exercise Sheet 6
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This exercise sheets is also due 1. June.

1 Dimensionality Reduction – continued

In the last exercise you have worked with the dataset from the Armband robot. You noticed that PCA is not capable of creating a low-dimensional description where for the velocity of the robot is nicely represented. This might have different reasons. 1: the required mapping is nonlinear and 2: a single snapshot of the sensor values might not be very discriptive for the motion of the robot. That is why this time we try some delay embedding and ISOMAP as a non-linear method.

Use the same datafiles as last time: Lines starting with '#' are comments and the line starting with '#C' contains the labels for each column.

(a) `Sliderwheelie-pimax-env.x.log` contains the sensor readings which are the joint angles and slider positions. First column is the time, which is to be ignore. The remaining 18 columns contain the data.

(b) `Sliderwheelie-pimax-env.v2.log` contains the velocity of the robot in horizontal and vertical direction, which is something the robot has **no** access to in reality.

1.1 Delay Embedding and ISOMAP

Instead of x_t as inputs, use $(x_t, x_{t-1}, \ldots, x_{t-\tau-1})$, i.e. the concatentation of τ time steps (delay embedding).

(a) Perform ISOMAP (`sklearn.manifold.Isomap`) with 10 neighbors to a 3-dimensional space.

(b) Visualize the data in the resulting space and color it with the velocity of the robot. (Hint: plot coordinate 1 against 2 and 2 against 3, or try a 3d scatter plot.)

(c) Try this for different τ (and try $\tau = 5$)

(d) Look at the mapped sensor data over time, does it make sense?

(e) So maybe only the delay-embedding was important to do. Try PCA on the delay-embedding with $\tau = 5$.

What did you learn?